What is claimed is:

1. A device for the characterization of polymer molecules, comprising:
a substrate forming a base of the device, the substrate including an aperture therethrough;
a thin film disposed on the substrate and extending across the aperture so that the thin film is self supporting over an area defined by the aperture;
a channel formed by a direct electron beam drilling process through the thin film in the area defined by the aperture, wherein the channel is 1-10 nm in diameter so as to allow passage of polymer molecules therethrough so that as a polymer molecule passes therethrough a given monomer will cause a detectable change in the thin film wherein the detectable change will characterize the monomer.

2. The device of claim 1, wherein channel formed by the direct electron beam drilling process is formed by a TEM drilling process.

3. The device of claim 2, wherein the channel is measured using the TEM.

4. The device of claim 3, wherein the formation of the channel and the measurement of the channel are performed in one presentation to the TEM instrument.

5. The device of claim 1, further comprising
a container for holding a fluid medium having a quantity of polymer molecules disposed therein, wherein the substrate including the thin film is disposed within the container and divides the fluid medium into a first pool and a second pool wherein polymer molecules are directed from the first pool through the channel and into the second pool by generating a voltage differential across the thin film.

6. The device of claim 1, further comprising:
a first electrically conductive layer disposed within the thin film so as to form a first set of electrically independent leads, wherein each lead has a first end and a second end and the first end of each lead is proximate the channel.

7. The device of claim 6 wherein the first end of each lead of the first set forms a portion of a perimeter of the channel.

8. The device of claim 6 wherein the first set of electrically independent leads comprises two leads positioned on opposite sides the channel.

9. The device of claim 6 wherein the first set of electrically independent leads comprises four leads positioned evenly around the channel in a quadrapole arrangement.

10. The device of claim 6, further comprising:

a second electrically conductive layer disposed within the thin film so as to form a second set of electrically independent leads, wherein each lead has a first end and a second end and the first end of each lead is proximate the channel.

11. The device of claim 10 wherein the first set of leads is separated from the second set of leads by a dielectric layer.

12. The device of claim 10 wherein the first end of each lead of the second set forms a portion of a perimeter of the channel.

13. The device of claim 10 wherein the second set of electrically independent leads comprises two leads positioned on opposite sides the channel.

14. The device of claim 10 wherein the second set of electrically independent leads comprises four leads positioned evenly around the channel in a quadrapole arrangement.

15. The device of claim 1, further comprising:

a first electrically conductive layer disposed within the thin film so as to form a first electrical lead;

a second electrically conductive layer disposed within the thin film so as to form a second electrical lead, wherein the second electrically conductive layer is separated from the first electrically conductive layer by a dielectric layer, so that the channel is formed to pass through the first electrically conductive layer, the dielectric layer and the second electrically conductive layer.

16. The device of claim 1 where the substrate is silicon.

17. The device of claim 1 wherein the aperture has micro-scale dimensions and the channel has nano-scale dimensions.

18. The device of claim 1 wherein the channel has a diameter of between 2-5 nm.

19. A method of forming a membrane structure for use in a device to characterize polymer molecules, comprising:

providing a support substrate of a predetermined material;

depositing a thin film on the support substrate;

etching a hole through the support substrate that removes all of the material in a predetermined area so that the thin film is self supporting over the predetermined area; and

drilling a nano-scale channel through a self supporting portion of the thin film.

20. The method of claim 19, wherein the act of drilling comprises using a TEM instrument.

21. The method of claim 20, wherein the act of drilling further comprises using a SCRIBE process.

22. The method of claim 20, further comprising measuring the channel using the TEM instrument.

23. The method of claim 22, wherein the act of drilling and measuring are performed during a single presentation to the TEM instrument.

24. The method of claim 19 wherein the channel has dimensions that allow passage of polymer molecules therethrough so that as a polymer molecule passes therethrough a given monomer will cause a detectable change in the thin film wherein the detectable change will characterize the monomer.

25. The method of claim 19 wherein the channel has a diameter of 2-5 nm.

26. The method of claim 25 wherein the thin film has a thickness of about 30 nm or less.

27. The method of claim 19 wherein the support substrate is silicon.

28. The method of claim 19 wherein depositing the thin film further includes:

providing a layer of electrically conductive material having a predetermined pattern such that boring the channel separates the layer into a plurality of independent conductive leads.

29. The method of claim 28 wherein two conductive leads are formed.

30. The method of claim 28 wherein four conductive leads are formed.

31. The method of claim 19 wherein depositing the thin film further includes:

providing a layer of electrically conductive material having a predetermined pattern; and

removing a predetermined amount of the layer of electrically conductive material so that when the channel is drilled, the remainder of the layer of electrically conductive material is separated into a plurality of conductive leads.

32. The method of claim 31 wherein two conductive leads are formed.

33. The method of claim 31 wherein four conductive leads are formed.

34. The method of claim 19 wherein depositing the thin film further includes:

providing a first layer of electrically conductive material having a predetermined pattern such that drilling the channel separates the layer into a plurality of independent conductive leads;

providing a layer of a dielectric material over the first layer of electrically conductive material;

providing a second layer of electrically conductive material having a predetermined pattern such that drilling the channel separates the layer into a plurality of independent conductive leads, wherein the second layer of electrically conductive material is provided such that the dielectric material separates the second layer of electrically conductive material from the first layer of electrically conductive material.

35. The method of claim 34 wherein two conductive leads are formed in the first layer and two conductive leads are formed in the second layer.

36. The method of claim 34 wherein four conductive leads are formed in the first layer and four conductive leads are formed in the second layer.

37. The method of claim 19 wherein depositing the thin film further includes:

providing a first layer of electrically conductive material having a predetermined pattern;

removing a predetermined amount of the first layer of electrically conductive material so that when the channel is bored, the remainder of the first layer of electrically conductive material is separated into a plurality of conductive leads;

providing a layer of dielectric material;

providing a second layer of electrically conductive material having a predetermined pattern, where the dielectric material separates the first layer of electrically conductive material from the second layer of electrically conductive material; and

removing a predetermined amount of the second layer of electrically conductive material so that when the channel is bored, the remainder of the second layer of electrically conductive material is separated into a plurality of conductive leads.

38. The method of claim 37 wherein a focused ion beam is used to remove the predetermined amount of the electrically conductive layer from the first layer and from the second layer.

39. The method of claim 37 wherein two conductive leads are formed in the first layer and two conductive leads are formed in the second layer.

40. The method of claim 37 wherein four conductive leads are formed in the first layer and four conductive leads are formed in the second layer.

41. The method of claim 19 wherein depositing the thin film further includes:

providing a first layer of electrically conductive material;

providing a layer of dielectric material;

providing a second layer of electrically conductive material such that the layer of dielectric material separates the first layer of electrically conductive material from the second layer of electrically conductive material and the channel passes through the first layer of electrically conductive material, the dielectric material and the second layer of electrically conductive material.

42. The method of claim 19 wherein etching the hole includes using lithography.

43. Molecular information gathered using the method of claim 22.

44. Molecular information gathered using the device of claim 3.